

The occurrence of Melanterite in Baluchistan.—By DAVID HOOPER, F.C.S.

[Received 27th May, 1903. Read 3rd June, 1903.]

During the last cold weather, Mr. R. Hughes-Buller, C.S., Superintendent, Imperial Gazetteer, Baluchistan, forwarded several samples of economic products to the Indian Museum for identification. Among these were two specimens of minerals called *Khaghal* and *Pulmák* which were employed in the Brahui method of dyeing in conjunction with pomegranate husk in producing black or deep green colours.

A special interest attaches to the production of *Khaghal*, otherwise known as *Zagh*, on account of a note drawn up by Mirza Sher Mahomed, describing one of the mines in the Jalawan district. It appears that the collection of *Khaghal* is a regular industry in two or three localities in Baluchistan. One of the mines is about forty miles from Nargana, and at Tango, about a mile distant, is another mine, situated at the foot of the hill and on the bank of a river. The entrance to the mine is an opening about a yard wide leading into a gallery of unknown length. The *Zagh* has been collected from these mines for several years, and although large quantities of mineral have been taken away, only a small area of about two yards has been worked. It is always mixed with a slate-like stone. The narrow gallery forming the mine is called "Ragh," a vein of the hill. The inhabitants say that after a rainfall pure white *Zagh* "bursts out" in the mine which in the dry weather is dug out together with the decomposed slate. The mine has a disagreeable corrosive smell "like iron rust," and this causes the workmen to vomit in the course of half an hour. Further samples were sent by Mr. Hughes-Buller, one from Ladon Pass, said to be of superior quality, and another from Bhapar which was very inferior. It has also been discovered at Chotok on the Kil river, Mula Pass, and at two places at Khuzdar.

The mine at Chotok is in a gorge, at a distance of six miles west of Janh. Here a cave is formed in the hill with a pool of warm water, noted for its mineral properties, and overhead is a rock from which water drops from innumerable stalactites of fantastic shape. The length of the pool is 150 yards, through which guides conduct visitors after they have undressed. At about ten yards from the entrance of the gorge is a large cave on the bed of which the mineral incrustation known

as *Khaghal* forms. This is of a yellow colour and is said to be in an excellent condition for dyeing purposes.

Upon examining the samples of *Khaghal* it was soon discovered that they were impure forms of ferrous sulphate or green copperas. The sample from Ladon Pass contained 30·1 per cent., of anhydrous ferrous sulphate, and that from Kil Chotok 27·36 per cent. Analyses of the water-soluble portions of the minerals revealed the fact that in addition to the iron salt sulphates were present of other available metals peculiar to the rock. The following tables indicate the composition :—

		Ladon Pass.	Kil Chotok.
FeSO ₄	...	30·10	27·36
Al ₂ 3 SO ₄	...	4·50	4·02
CaSO ₄	...	3·12	3·78
MgSO ₄	...	1·20	1·50
K ₂ SO ₄	...	·74	·27
Na ₂ SO ₄	...	2·06	2·86
		41·72	39·79

The minerals contained about 40 per cent. of matter insoluble in water consisting of silica, iron, alumina and lime. These estimations leave a balance of about 20 per cent. which might be referred to water of crystallisation.

The specimen of *Khaghal* from Bhapar yielded to hot water only a small quantity of sulphate of alumina with traces of calcium sulphate, and was therefore almost valueless as a dye or mordant.

Melanterite or native ferrous sulphate is usually the product of the decomposition of pyrites and occurs as an efflorescence on the out-crop of rocks containing a considerable quantity of this mineral. But in volcanic regions it appears to be formed by the chemical action of sulphurous vapours upon siliceous and oxidised ores of iron. There are volcanic regions in Baluchistan where sulphur is obtainable and where sulphurous fumes are constantly acting upon the surrounding rocks converting the metals into sulphates. The *Khaghal* mines of Nargana and Chotok provide the conditions of warmth, air, and moisture necessary to promote the combination of sulphurous acid and iron and the ultimate conversion into crystallised sulphate.

Iron sulphate has already been found in India in the following places: Shekawati, Rajputana; ¹ hills of the Kakur district, Afghanis-

¹ J. C. Brooke, *J. As. Soc. Beng.*, Vol. xxxiii., 529.

tan;¹ in the Ramganga and Garja Valleys, in Kumaon;² on shales of the Kaimur tableland, Central Provinces;³ in the Langyin Valley, Central Assam; and at the headwaters of the Attaran River, Tenasserim.⁴ That the green copperas as used as a dye is often very impure, is shown by an analysis of a sample made by J. Stevenson in Bihar⁵ who found 39 per cent. of anhydrous ferrous sulphate; the pure crystallised sulphate should yield, according to the formula $\text{FeSO}_4, 7 \text{H}_2\text{O}$, about 54 per cent. of the anhydrous salt.

A note might be added regarding the mineral *Phulmák*, sent by Mr. Hughes-Buller as a mordant in dyeing employed by the Brahuis, or inhabitants of the highlands of Baluchistan. *Phulmák* is found in the Koh-i-Sultan, a hill in the Western Sanjrani district. At Kundi, south of the Koh-i-Sultan, some of this "mak" was found in the course of sinking a well. The water was consequently very saline and unfit for drinking purposes. The average price paid by the Nashki Banias for *Phulmák* varies from Rs. 5 to Rs. 6 per maund. It is said to be used as a mordant while *Zagh* is used as a dye.

This mineral has recently been described by Mr. E. Vredenburg in his "Geological Sketch of the Baluchistan Desert" (*Memoirs of the Geological Survey of India*. Vol. xxxi., Pt. 2 (1901), pp. 278-279.) Describing the region of the solfataric volcano, Koh-i-Sultan, Mr. Vredenburg states—"The clays are impregnated with sulphate of alumina, which is extracted and used as a mordant under the name of "Koh-mak." The efflorescent salt is known as "Phul-mak."

Mak is a term given to the soft ferruginous lithomarge, occurring in the hills south of Saindak and in the Koh-i-Sultan, and is collected and carried to Kandahar for dyeing purposes by Kakars and Babars. (T. H. Holland, *Records of Geological Survey of India*, Vol. xxx., 129) *Mak* or *Lak* was also collected by Major G. W. Brazier Creagh, I.M.S., from the Cheltan Range and was reported to give a black dye called *Lak-i-Siah* with leaves of the Kangak shrub. Specimens examined in the Laboratory of the Geological Survey were pronounced to be yellow marl containing large quantities of sulphate of iron. (*Ib.*, Vol. xxx., 253).

Although the substance termed *Mak* appears to differ in appearance and properties, the identity of the *Phulmák* has been set at rest by an examination of two samples sent by Mr. Hughes-Buller. One speci-

¹ T. Hutton, *Calcutta Journ. Nat. Hist.*, Vol. vi., 597.

² J. D. Herbert, *Asiatic Researches*, Vol. xviii., Pt. 1, 229.

³ F. R. Mallet, *Memoirs G.S.I.* Vol. vii., 121.

⁴ E. Riley, *Journ. Ind. Archipelago*, Vol. iii., 395.

⁵ *Geology of India*, Vol. iii., 419.

men was in white granular cakes, and the second contained in addition masses of white silky crystals. On analysing the soluble portion of each it was proved that the mineral was *Alunogen* or "Hair Salt," with a composition of : Alumina 15·3, sulphuric acid 36 and water 48·7 per cent. This composition agrees with the formula of *Alunogen*, viz., $\text{Al}_2\text{O}_3 \cdot 3 \text{SO}_3 \cdot 18 \text{H}_2\text{O}$.

Himalayan summer storms and their influence on monsoon rainfall in Northern India.—By C. LITTLE, M.A.

In a paper which I read at the April meeting of this Society I pointed out that the monsoon season of 1902 could be divided into four periods, in each of which the character of the season as regards the distribution of rainfall and the movement of cyclonic storms which entered India from the Bay of Bengal were noticeably different. I gave a number of tabular statements showing that important changes appeared in the Himalayan region about the 30th of June and the 11th of August, that these changes did not begin over India, and that there was abundant reason for the belief that they approached India from Central Asia, that is, from an easterly or north-easterly direction. I gave the paper the title of "Two remarkable rainbursts in Bengal," because the unexpected occurrence of heavy rainfall in north-eastern India attracted my attention and led to the subsequent investigation.

Although the present monsoon season is not yet half over, there have, in my opinion, been already no fewer than three occasions on which the weather in Northern India has been influenced by similar disturbances, that is, by disturbances which have made their first appearance in the region of the Himalayas. I have called them Himalayan storms because they come within our range of observation when they reach the hills; but the probability is that they are due to depressions moving across Central Asia. Their appearance begins with an irregular fall of the barometer at stations in Northern India, and an indraught of winds in that direction: after a longer or shorter period pressure begins to rise, and this rise of pressure is accompanied by the commencement of rainfall, not I believe rainfall of the monsoon type, but the irregularly distributed, and often heavy rainfall caused by numerous thunderstorms.